PATENT SPECIFICATION

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(54) WATER PURIFICATION APPARATUS

(71) We, DYNEK CORPORATION, a corporation organised and existing under the laws of the State of New York, United States of America, of 160 Irving Avenue, Port Chester, New York 10573, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to water purification apparatus which is particularly, although not exclusively, suited for domestic use for improving the purity and potability of water.

It is a well known fact that, as population densities increase, it is increasingly difficult to provide sufficient water for domestic use which is of satisfactory purity and potability. Because of this, the purity and quality of drinking water, even from municipal water systems, is increasingly poor, and often very unsatisfactory. Furthermore, in addition to industrial and domestic pollution related to high population densities, drinking water in many locations is disagreeable in odor and taste because of materials dissolved in the water which are not necessarily harmful, but which reduce the potability of the water.

Contaminants which affect the taste of water are particularly annoying for consumers who are not regular residents of the area to which the water is supplied. Also, contaminants which affect the taste of water are particularly annoying for purposes such as the brewing of coffee, where the taste of the end product is drastically affected by the contamination.

At the present time, it appears likely that the contamination of ground water may proceed to become so bad in some communities that it will be absolutely essential for each household to take precautionary measures to purify and improve the potability of the water which the members of that household ingest, either as drinking water, or for cooking.

Because of these factors, a number of filtration devices have been proposed in the past for the purpose of improving drinking water. However, these prior devices have generally been quite ineffective because of deficiencies and inadequacies of design. Most commonly, such filters have employed only one filtration medium generally charcoal, and have thus been limited in effectiveness to removal of only those contaminants for which that medium is effective. These contaminants are generally organic materials and odoriferous materials and dissolved halogens which may combine readily with the carbon in the charcoal. However, there are many more serious contaminants, such as disease and illness-causing bacteria, which are not effectively removed by charcoal. It has been generally thought to be necessary, in order to remove bacteria, to boil or distil drinking water for domestic use.

According to the present invention there is provided water purification apparatus comprising a portable container having a water reservoir compartment for storing untreated water and a pumping compartment in juxtaposition to said reservoir compartment, said water reservoir compartment having a bottom wall, an inlet for adding untreated water to said reservoir compartment and a water outlet passage in said bottom wall, water pumping means having an inlet and an outlet, said pumping means being mounted within the pumping compartment of the portable container and having said inlet thereof connected to the water outlet passage of the water reservoir compartment for receiving water directly from said reservoir compartment, and a filter device removably mounted within said water reservoir compartment of said container, said filter device having an inlet connected to the outlet of said water pump means and an outlet nozzle integrally constructed within the filter device

extending over the upper edge of said container, whereby untreated water placed in the reservoir is pumped from the reservoir through the filter device for purification and pumped out the integral outlet nozzle of the filter device. Such apparatus may be economical in cost and operation and is suitable for domestic use.

The filter device may include a unitary housing having said inlet and said outlet nozzle, a first filter means mounted within the housing in juxtaposition to the inlet and having pore openings for removing solid particulate matter from water pumped through the first filter means, a particulate filter means mounted above the first filter means for removing organic contaminants and odour producing constituents in the water passing through the housing, the first filter means being adapted to distribute water substantially uniformly to the particulate filter means, and an upper filter means mounted above the particulate filter means and having finer pores than said first filter means for clarifying the water passing through said upper filter means.

A filter of the above type wherein the outlet nozzle extends laterally outward from said housing for passing filtered water out of the filter in counter current flow to the flow of water through the housing. Forms the subject of our co-pending application No. 8540/76 (Serial No. 1,448,845) which has been divided from the present application.

If the particulate filter means is coated with a bacteria-preventing means the filter will reduce or avoid the problem of bacterial growth in the filter during periods when the apparatus is inactive. Furthermore the filter media is very easily replaced or recharged. The construction may be such that different combinations of filtration media may be supplied for different water contamination conditions, and the filter media may be quickly and easily selected to cope with the specific contamination conditions encountered.

Dissolved minerals and mineral salts may be removed from the water to provide a demineralized product for use as drinking water for persons who must restrict mineral intake, and for other purposes for which water must usually be distilled for removal of mineral content.

A preferred embodiment of the invention will now be described by way of example, with reference to the accompanying drawings, of which:—

Fig. 1 is a side view, partly in section, of a water purification apparatus in accordance with the present invention.

Fig. 2 is a top view of the apparatus with the cover removed, and showing the filter device only in phantom to indicate the position of the filter device when assembled, and

Fig. 3 is a sectional side view of a filter device which is suitable for use in the apparatus of Fig. 1.

Referring more particularly to Fig. 1, there is shown, partially in section, a water purification apparatus in accordance with the present invention. It includes a supply container 10 supported upon a base 12. Within the supply container there is fastened a filter device 14 which includes an integral discharge spout 16 which extends out over the edge of the container. Attached at the bottom of the supply container 10 and preferably forming an integral part of the container, there is a pump 18 arranged to receive water through an outlet opening 20 in the bottom of the container, and for pumping the water through a pump outlet passage including a hose connection 22 and a fitting 24, and thus into the filter device 14.

The supply container 10 includes a continuous botton wall 26, and the base 12 has a continuous upper wall 28. These walls are secured together, thus securing the container 10 and the base 12 together, by means of the fitting 24 and the pump attachment. The fitting 24 includes a threaded nut 30, and the pump inlet attachment includes a threaded nut 32, by means of which the walls 26 and 28 are clamped together. A metal reinforcing plate 33 is also preferably clamped together with the walls 26 and 28, as shown. Beneath the flange of fitting 24 there is an "O" ring 39 which serves to provide a leakproof seal. The nut 32 is provided with a built-in seal, not shown.

The pump 18 is preferably of the non-positive displacement type, preferably of the centrifugal type, and capable of providing about 500 cubic centimeters of flow volume per minute at a pumping pressure in the order of 30 to 36 centimeters of mercury. The pump may preferably include an integral electric motor supplied with power through connections indicated at 34. The power may be 110 volt AC or 12 volts DC. If a 12 volt DC motor is used, power may be supplied through a small solid state DC power converter which is structurally combined with the power cord plug. A switch such as a toggle switch or a rocker switch 35 is provided in the side of the base 12 to turn the motor on and off as necessary. When portability is required, the pump may be energized by batteries. Also, if desired, a manually operated pump may be employed.

The base 12 also preferably includes a stand portion 36 for supporting and positioning a beaker 38 so that the beaker is

properly positioned directly beneath the spout 16. In order to position the beaker, the stand 36 preferably includes an outer upwardly extending rim or ring 40 to maintain the beaker in the correct position.

The outlet from the pump 18 is defined, in part, by the fitting 24 and an integral cylindrical protrusion or nipple 46 extending upwardly from the bottom of the container 10. Nipple 46 may be considered as an integral part of the container bottom 26. This nipple 46 extends into a bottom inlet opening bore 42 of the filter device 14. The filter device 14 requires a positive liquid pressure in the order of twenty-five centimeters of mercury. This requires that the connection from the nipple 46 to the filter device inlet bore 42 should be reasonably tight. This is accomplished by means of an "O" ring 44 mounted upon nipple 46 to provide a seal. However, it is one of the convenient features of the invention that if there is leakage of water from the discharge of the pump 18 at the connection provided by nipple 46 to the filter device 14, such leakage simply causes the water to bypass the connection and to flow back into the container. Thus, no serious harm results from such leakage. One of the main functions of the seal provided by O ring 44 is to prevent the pump pressure from pushing the filter device 14 up and off of the connection to nipple 46.

The container 10 is provided with a removable cylindrically shaped cover 48 which covers and protects the opening in the top of the container 10, and which surrounds and covers the spout 16 of the filter device 14. The filter device 14 is preferably formed in the shape of a frustum of a cone and is positioned within the container by means of an integral frame which is formed in the upper portion of the container 10. This is shown more fully in the top view of the apparatus in Fig. 2 and described below in connection with that figure.

In operation, the cover 48 of the container is removed, and water to be filtered is poured into the container, as indicated at 50. Power is then applied to the motor of the pump 18, as by turning on the switch 35, and the water is pumped from the bottom of the container through the pump inlet 20 and out through the hose connection 22, and the fitting 24 and thus into the filter device 14. The filtered water emerges from the spout 16 and flows into the beaker 38 as indicated at 52.

Fig. 2 is a top view of the apparatus of Fig. 1, with the cover 48 removed, and showing the outline of the filter device 14 only in phantom. As illustrated in this view, the upper portion of the container 10 is provided with a contoured cut-out opening which includes a circular sector portion 54 of reduced diameter, the circular sector portion 54 extending for more than 180°, actually in the order of 230° in the preferred embodiment. This circular sector portion is of the proper diameter to provide a loose fit with the circular upper periphery of the filter device 14, just under the level of the spout 16, so as to embrace and hold the upper portion of the filter device in the desired position. This sector portion of the upper container opening may be characterized as an integral frame defining an opening consisting of the circular sector 54 through which the filter device 14 may be inserted and removed, and providing a positioning support for the filter device. The upper portion of the filter device may include wing members indicated at 56 and 58 having back edges which are intended to be in alignment with corresponding edges 60 and 62 of the upper opening of the container 10 when the filter device 14 is in the proper rotational position with respect to the container 10. This assures that the spout 16 is properly positioned over the edge of the beaker 38.

As further illustrated in Fig. 2, the container 10 is provided with an arcuate indentation, as indicated at 64, which is of the proper radius so that the beaker 38 nests into the indentation 64. This further serves to properly position the beaker 38 with respect to the spout 16. However, even though the container 10 is in the shape of a cylinder interrupted by the cylindrical indentation at 64, the cover 48 illustrated in Fig. 1 is in the form of a complete circular cylinder so that it surrounds and covers the spout 16 as well as the top of container 10.

Fig. 3 is a cross sectional view of the filter device 14. The device 14 is seen to consist of a lower housing member 64 and a housing cover member 66, which are sealed together to comprise the total housing including the integral spout 16. Within the housing, and supported and secured upon a lower shelf formed integrally in the housing, is a distributor filter disc 68. In the upper portion of the lower housing member 64, and similarly positioned and secured at an integrally formed positioning shelf is an upper or final filter disc 70. Contained between the filter discs 68 and 70 there is a particulate filter media. While many different materials can be satisfactorily employed for the housing, a high impact polystyrene has been found to be ideal in one preferred embodiment.

The filter discs 68 and 70 may preferably consist of porous polyethylene. The distributor filter disc 68 may typically be in the order of three millimeters in thickness and is provided with pores of a nominal thirty five microns in diameter. This

distributor filter disc serves the purposes of filtering out gross solid impurities, serves to regulate the even flow of water into the filter, and acts as a distribution device to evenly distribute the water entering the filter through the particulate filtering material 72. The upper filter disc 70 is provided with much finer pores which are nominally ten microns in diameter. It is effective to clarify the water and to keep the particular filtering media 72 from leaking out of the filter device. The upper filter disc may also be in the order of two millimeters in thickness. Both of the filter discs 68 and 70 may have about a forty percent proportion of void.

The particulate filter media 72 may have various compositions which are specifically formualted to cope with local water purification problems. However, a very satisfactory filtering media where the objective is to provide potable water from contaminated sources is activated charcoal. The activated charcoal is effective to remove a variety of organic contaminants, and undesirable odor producing constituents from the water. It also is effective to remove chloride and a variety of other undesirable chemicals from the water. If serious purification problems are encountered, chlorine may be added to the water in the container 10 in order to kill the bacteria in the water. The chlorine, with its unpleasant taste and smell, is then removed by the charcoal in the filter. About ten to sixteen percent of the charcoal is coated with metallic silver, or a silver salt. The silver is effective to kill bacteria which may be in the water. The silver is also particularly important for the purpose of effectively preventing the growth of bacteria within the filter device when the apparatus is permitted to stand for a period of time without being used. Where metallic silver is used, the material is ionic silver. Various silver salts may be used, but silver nitrate is very effective and is preferred.

When reduction of the mineral content of the water is the major consideration, rather than mere potability of the water, the particulate filter medium is preferably a mixture of resin ion exchange media, different constituent portions of which are effective to combine with, and eliminate the different minerals in the water. With this filter media the housing 64—66 of device 14 is preferably composed of clear polystyrene so that a dye indicator is easily observable to indicate when the ion exchange media has been depleted in its metal removal action.

The particulate filter medium may be a combination of a plurality of ion exchange resins and a substantial proportion of activated charcoal with a silver-bearing coating on the activated charcoal.

It is one of the important preferred features of the filter device 14 that the thickness and porosity of the distributor filter disc 68 is such that, with typical water contamination conditions, the distributor filter disc 68 becomes depleted by becoming clogged with intercepted contaminant particles at about the same time that the particulate filter media 72 and the upper filter disc 70 also become depleted. The clogging of the distributor filter disc 68 progresses eventually to the point where no more water can be delivered through the filter device. The pump 18 being a non-positive displacement centrifugal pump, simply is not able to force water through the filter device. Thus, the user is quite aware of the fact that the filter device is depleted because the rate of water delivery is progressively reduced and finally essentially stopped. This is a convenient safety feature because the user is not deluded into thinking that his water has been adequately filtered and purified when the properties of the particulate filter media 72 have actually been depleted.

While this invention has been shown and described in connection with particular preferred embodiments, various alterations and modifications will occur to those skilled in the art.

WHAT WE CLAIM IS:—

1. Water purification apparatus comprising a portable container having a water reservoir compartment for storing untreated water and a pumping compartment in juxtaposition to said reservoir compartment, said water reservoir compartment having a bottom wall, an inlet for adding untreated water to said reservoir compartment and a water outlet passage in said bottom wall, water pumping means having an inlet and an outlet, said pumping means being mounted within the pumping compartment of the portable container and having said inlet thereof connected to the water outlet passage of the water reservoir compartment for receiving water directly from said reservior compartment, and a filter device removably mounted within said water reservoir compartment of said container, said filter device having an inlet connected to the outlet of said water pump means and an outlet nozzle integrally constructed within the filter device extending over the upper edge of said container, whereby untreated water placed in the reservoir is pumped from the reservoir through the filter device for purification and pumped out the integral outlet nozzle of the filter device.

2. Apparatus as claimed in claim 1 wherein the filter device includes a first

filter means in juxtaposition to the inlet to the filter device, the first filter means having pore openings approximately thirty five microns in diameter, said pore openings being sufficient to prevent coarse particles in the water from flowing through the filter device thereby forming a deposit of coarse particles upon the first filter means.

3. Apparatus as claimed in claim 2 wherein the pumping means is arranged to stop pumping water through the filter device upon an excessive accumulation of coarse particle deposits on the first filter means.

4. Apparatus as claimed in any of the preceding claims wherein the pumping means comprises a non-positive displacement pump.

5. Apparatus as claimed in any of the preceding claims wherein said pumping means is a centrifugal pump.

6. Apparatus as claimed in any of the preceding claims wherein the outlet of the water pumping means is a pump outlet passage, and the inlet to the filter device has a sealing means for sealing the connection between the filter device and the pump outlet passage.

7. Apparatus as claimed in claim 6 wherein the portable container has an integral frame mounted within the container for providing support for the filter device and permitting the filter device to be connected to and removed from the pump outlet passage.

8. Apparatus as claimed in any of the preceding claims including means for mounting a water beaker on said container below the outlet nozzle of the filter device as a receptacle for filtered water.

9. Apparatus as claimed in claim 8 wherein the means for mounting the beaker below the outlet nozzle comprises an integrally molded ring shaped member extending outward from the exterior portion of the container, said means including a stand for supporting the beaker in alignment with the outlet nozzle of the filter device.

10. Apparatus as claimed in claim 1 wherein the filter device includes a unitary housing having said inlet and said outlet nozzle, a first filter means mounted within the housing in juxtaposition to the inlet and having pore openings for removing solid particulate matter from water pumped through the first filter means, a particulate filter means mounted above the first filter means for removing organic contaminants and odour producing constituents in the water passing through the housing, the first filter means being adapted to distribute water substantially uniformly to the particulate filter means, and an upper filter means mounted above the particulate filter means and having finer pores than said first filter means for clarifying the water passing through said upper filter means.

11. Apparatus as claimed in claim 10 wherein the passages in the first filter means have pore openings approximately thirty five microns in diameter to prevent coarse particles in the water from flowing through the filter device, thereby forming a deposit of coarse particles upon the first filter device.

12. Apparatus as claimed in claim 11 wherein the particulate filter means comprises activated charcoal.

13. Apparatus as claimed in claim 12 wherein the activated charcoal is coated with a bacteria-preventing means to prevent the growth of bacteria within the particulate filter means.

14. Apparatus as claimed in claim 13 wherein the activated charcoal is coated with silver to prevent the growth of bacteria within the particulate filter means.

15. Apparatus as claimed in claim 13 wherein the coating on the activated charcoal comprises a silver salt to prevent the growth of bacteria within the particulate filter means.

16. Apparatus as claimed in claim 15 wherein the silver salt is silver nitrate.

17. Apparatus as claimed in any of claims 10 to 16 wherein the upper filter means has passages with pore openings approximately 10 microns in diameter.

18. Apparatus as claimed in claim 10 wherein the particulate filter means comprises at least one ion exchange resin for removing minerals from the water.

19. Apparatus as claimed in claim 10 wherein the particulate filter means comprises a plurality of ion exchange resins, each of said resins being adapted to remove a particular mineral from the water.

20. Apparatus as claimed in claim 10 wherein said particulate filter means comprises the combination of at least one ion exchange resin and activated charcoal having a silver compound coating upon the activated charcoal.

21. Water purification apparatus having the features of claim 1 substantially as described herein with reference to the accompanying drawings.

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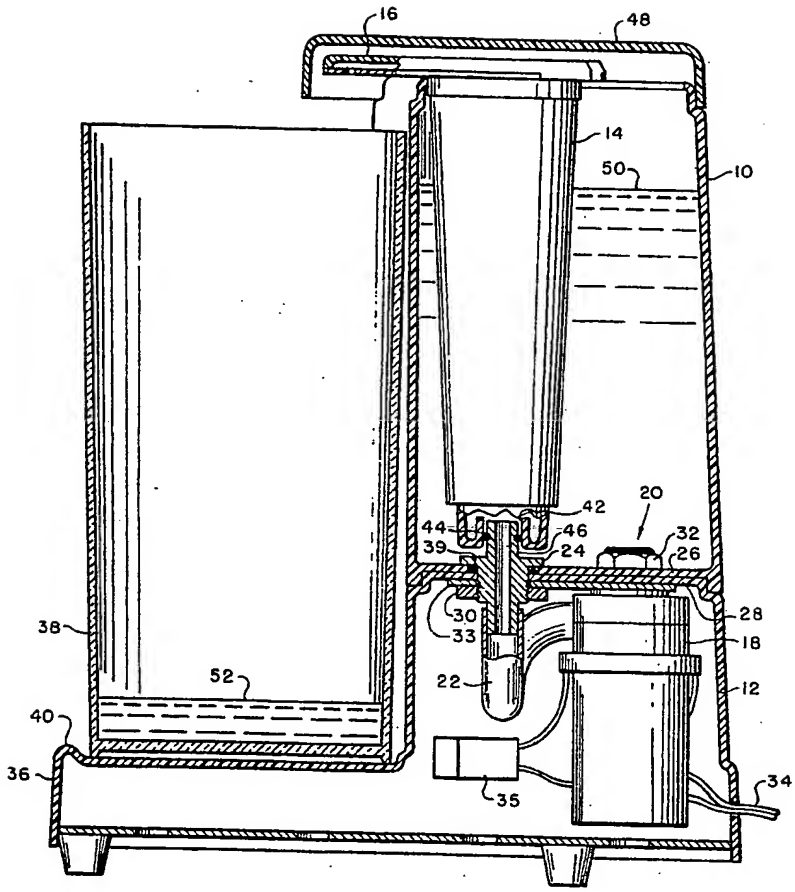
FIG_ 1



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Sheet 2

FIG_ 2

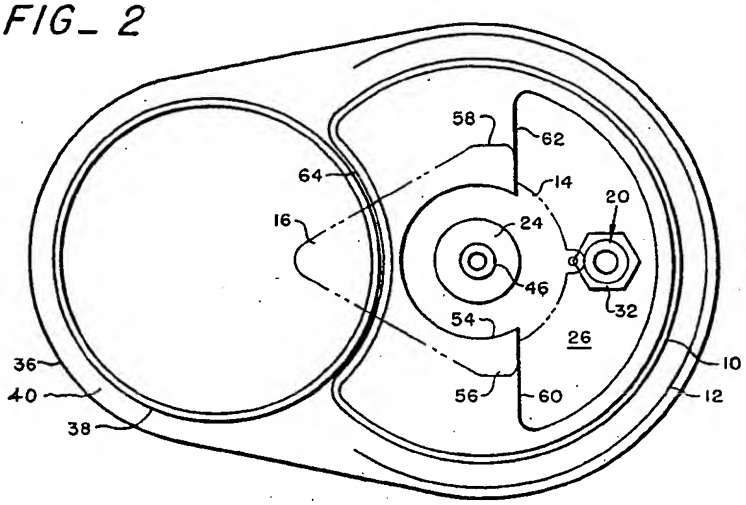

FIG_ 3